Instruction Manual

4-Quadrant Amplifier
Type PAS 1000

Serial No.: UO467 01/1 0613

1. General Instructions

This device has been shipped in perfect safety condition. However, it has to be checked for mechanical defects before the first start-up. If there is any transportation damage the device must not be put into operation. Spitzenberger & Spies has to be informed immediately.

Important Reference: **The devices/racks must only be moved/transported in upright position! Exceptions are only permissible after consultation with the manufacturer! The customer is liable for defects caused by disregarding this regulation.**

2. Safety

The device must only be operated by instructed personnel !

The chassis ground of the device is connected to earth.

Energized components might be uncovered when opening the housing.

Warning: **Capacitors might still be charged even if the amplifier is disconnected from all voltage sources.**

Keep a three-minute waiting period before opening the device after having disconnected the device from each voltage sources (power supplies).

The amplifier output is not electrically isolated from the mains. There is no protection by electrical separation according to the relevant regulations .

3. Connection

Before connecting the amplifier please make sure that the line voltage and frequency correspond with the device's. **Three-phase systems require the n-type conductor.** Note that the protected earthing conductor has to be connected according to regulations. The earthing resistance has to meet the relevant safety regulations. Insufficient connection of the protected earthing conductor might cause malfunctions of the system. We recommend to supply the system via fault-current circuit breaker.

Mains voltage	230V (±10%)
Mains frequency	50Hz/60Hz
Mains protection	16A
Releasing characteristics (recommended)	C or D
Fault-current circuit breaker (recommended)	≥ 30mA
Mains plug	Earthing contact socket 16A

Important References:

When the device/system is fixed to the mains (no plug) we recommend to install a main switch in order to ensure safe separation from the mains..

When controlling the device/system via PC the latter should be supplied by the same mains..

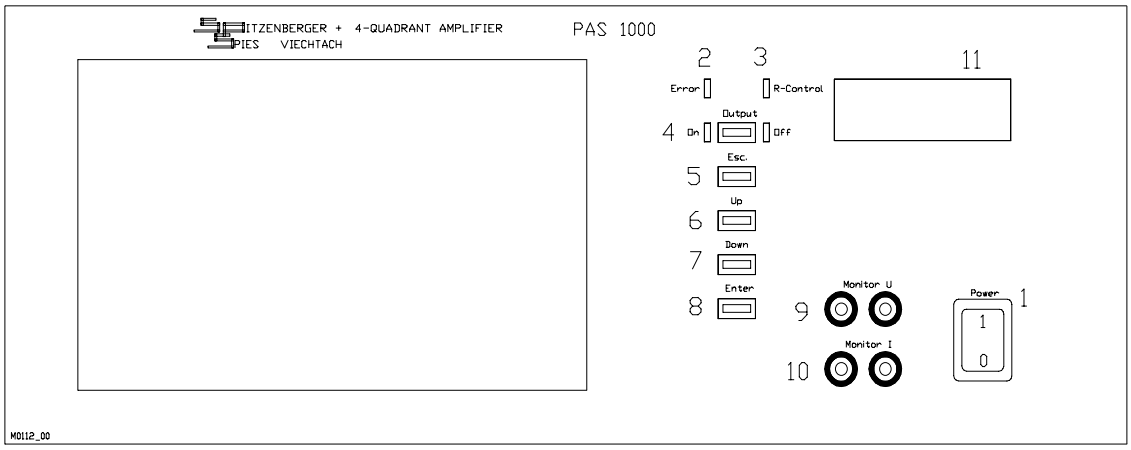
To make sure that the device/system works faultlessly and no overheating occurs, sufficient ventilation and enough distance from the device's rear side to any wall has to be guaranteed (60cm recommended). Please note that there must be 20cm distance between the individual racks !

The amplifier must only be operated within the stated Technical Data (see section 4.6). The frequency range of the amplifier is specified with 5kHz signal band width (optional: 15kHz or 30kHz). When the amplifier is controlled externally or with a signal generator type SyCore, in order to reach the small signal band width, frequencies larger than the maximum signal band width can be generated. When frequencies larger than the signal band width (max. signal band width up to 50kHz) are adjusted please note that only amplitudes up to max. 10% of the upper range value are permitted!

4. Power Amplifier Type PAS

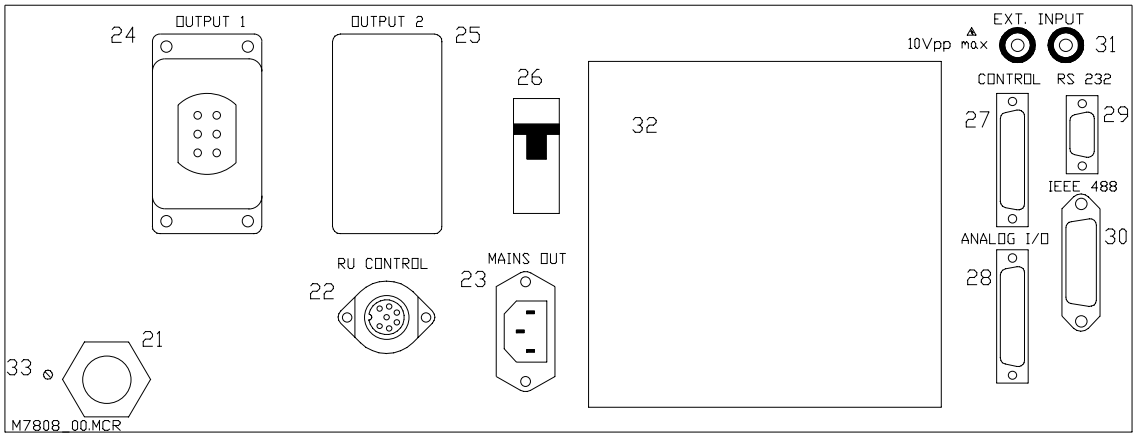
The amplifiers of the PAS series are linearly working transistor amplifiers with short-time and peak output power. The full nominal power is supplied at a power factor of 0,7 inductive - 1 - 0,7 capacitive. By means of the direct negative feedback the harmonic distortion, the phase shifting between control- and output signal just as the internal resistance and thus the voltage reduction at load are very low.

4.1. Front Panel Amplifier



Pos.	Lettering	Component/Function
1	POWER	Mains switch
2	ERROR	LED display: overload of the amplifier
3	R_CONTROL	LED display: remote control via external control (e.g. SyCore); computer control via RS 232
4	OUTPUT	Push-button and LED display: output „ON-OFF“
5...8	ESC; UP; DOWN; ENTER	Push-button: menu control
9	MONITOR U	Monitor output voltage (optional)
10	MONITOR I	Monitor output current (optional)
11		Display

4.2. Rear Panel Amplifier



Pos.	Lettering	Component/Function
21		Cable gland: Mains supply
22	RU_CONTROL	Socket series 692/6+PE: Remote control operation
23	MAINS OUT	Socket: Mains supply for additional devices (e.g. SyCore)
24	OUTPUT 1	Socket HAN6 HSB-bu: Amplifier output 1
25	OUTPUT 2	Socket HAN6 HSB-bu: Amplifier output 2 (not fitted)
26		Mains fuse 16A
27	CONTROL	25-pole. SUB-D socket: Control line SyCore
28	ANALOG I/O	25-pole. SUB-D plug: Signal line SyCore
29	RS232	9-pole SUB-D plug: Interface connection
30	IEEE 488	Micro Ribbon 24-pole series 57F: IEEE-488-plug
31	EXT. INPUT	Sockets: external input
32		Output stages
33		Earth protective conductor

Pin assignment please see section 4.7.1.

4.3. Amplifier Operation

In this section the various adjustment possibilities and the basic operation are explained.

Reference: In remote control operation the amplifier can't be controlled with the integrated keyboard (see section „Remote Control Operation").

4.3.1. Menu Control

After switching on the device the following menu is displayed:

```
    0.0 V     0.0 A
    0.0 VA     50 Hz
> Voltage:    0.0 V
  AUTO AC
```

The first line displays the measurement values voltage and current.

The second line displays the apparent power calculated from voltage and current and the adjusted frequency.

The third line displays is the main menu. In the fourth line present short information are output.

Reference: Some adjustments e.g. voltage range or frequency can be stored. When switching on of the device these values are set automatically. Therefore, the above shown display can differ from the display of your device.

With the keys UP, DOWN, ENTER and ESC the menu can be controlled. In the main menu you can switch the menu items with the keys UP and DOWN. Here the menu line in the display always changes.

The following menu items are available:

Menu item	**Section**	**Short description**	
Range:	4.3.4	Adjustment of amplifier range	S
Mode:	4.3.5	Amplifier mode AC- or DC-operation	S
Voltage:	4.3.6	Voltage adjustment	O
Frequ:	4.3.7	Frequency adjustment	O
Trigger:	4.3.8	Trigger angle adjustment	O
Lokal:	4.3.9	Set device into manual operation	S
Setup:	4.3.10	General adjustments e.g. IEEE address	S
Monitor:	4.3.11	Divider ratio of current measurement	O
I-Limit:	4.3.12	Adjustments for current limitation	O
R:	4.3.16	Adjustment of the real internal resistance	O
L:	4.3.16	Adjustment of the inductive internal resistance	O

O = optional
S = standard-type

The selected menu item is called up by pressing the key ENTER. According to the selected menu item you get to a new window, a selection field or a edit field.

Selection field:

Selection with the keys UP and DOWN. The selection is accepted with ENTER then you get back to the menu. When pressing ESC, the initial selection is maintained then you get back to the menu.

Edit field:

In the edit fields there are two possibilities for the input of values. At the first selection of an edit field you get to the incremental mode; here you can increase or decrease the indicated value incrementally with the keys UP and DOWN. The increment increases by and by. In the incremental mode the new values are accepted immediately, that means that e.g. at an incremental increase of the voltage the amplifier output voltage also increases.

If you are in the incremental mode and press ESC the present value remains and you get back to the main menu. If you alternatively press ENTER you get into the single-step mode. Every single digit can be adjusted to the requested value with the keys UP and DOWN. With ENTER you get to the next digit. The value is accepted after confirming the last digit with ENTER and you get back to the main menu. When pressing the key ESC, the adjusted value is not accepted.

4.3.2. Switch on

The amplifier can be switched on and/or off by means of the mains switch „POWER“. After approx. 10 seconds the device is ready for operation.

After switching on the following device status is adjusted:

- The signal lamp of the mains switch lights.
- The signal lamp for „OUTPUT OFF“ lights.
- The start menu is displayed.
- The fans for cooling the output stages are active.

4.3.3. Output

The amplifier output is switched on and/or off with the push-button „OUTPUT“. When the output is switched-off the output socket is isolated from the amplifier output by means of a relay. Switching on/off is always made wattless that means at switching first of all the control voltage is disconnected before changing the output. After changing the output the control voltage is released again.

The green signal lamp „OFF“ indicates:

- The amplifier output is switched off.

The red signal lamp „ON“ indicates:

- The amplifier output is switched on; dangerous contact voltage may occur at the amplifier output.

Caution: A damaged LED can cause an error in indicating the status of the output contactor. Therefore a regular check of the status indicator LED’s (e.g. with a multimeter at the output terminals) is recommended.

4.3.4. Voltage Range

With the different voltage ranges the amplifier can be optimised (maximum output power).

Move the cursor in the main menu by means of the keys UP or DOWN to **„Range“** and press ENTER. Now you can adjust the requested range in the selection field.

The following ranges are available:

60V
150V
300V
630V DC
AUTO The range is adjusted automatically.

At “AUTO” adjustment the most suitable voltage range is checked and adjusted automatically.

Range switching is always made wattless. Therefore, the control voltage is disconnected before changing the range. After changing the range the control voltage is released again, the output remains off.

Reference: The range „AUTO“ is only available with the option „internal oscillator“.

4.3.5. Coupling

The connection between control source and amplifier output can be changed with the coupling mode.

Move the cursor in the main menu by means of the keys UP or DOWN to **„Mode“** and press ENTER. Now you can adjust the requested amplifier mode in the selection field.

The following coupling modes are available:

DC DC-Mode
AC AC-Mode

In DC-mode the control source is connected directly to the amplifier output.

In AC-mode a capacitive filter is connected between input signal and amplifier input in order to filter out DC-components of the input signal. This operation mode is advantageous when testing loads e.g. transformers (saturation by DC).

Mode switching is always made wattless. Therefore, the control voltage is disconnected before changing the mode. After changing the mode the control voltage is released again.

4.3.6. Voltage (optional)

The oscillator type DDS2 (optionally available) can be used as control source.

Move the cursor in the main menu by means of the keys UP or DOWN to **„Voltage“** and press ENTER. Now you can adjust the requested output voltage in the edit field.

The maximum adjustable voltage value is limited by the present voltage range. See section „voltage range“.

4.3.7. Frequency (optional)

When using the internal oscillator DDS2 the frequency can be adjusted in the menu.

Move the cursor in the main menu by means of the keys UP or DOWN to **„Frequ“** and press ENTER. Now you can adjust the requested frequency in the edit field.

At a frequency input of 0Hz the amplifier is switched to the DC operation mode automatically.

4.3.8. Trigger Angle (optional)

The time of a voltage change can be altered by setting the trigger angle.

Move the cursor in the main menu by means of the keys UP or DOWN to **„Trigger“** and press ENTER. Now you can adjust the requested trigger angle in the edit field.

For changing e.g. the voltage at 90° a trigger angle of 90 has to be adjusted. As a result, every voltage change is carried out at 90°.

Reference: The adjustment of the trigger angle has no effect on frequencies < 10Hz and DC voltage.

4.3.9. Remote Control Operation

If the amplifier is controlled via RS232 and/or IEEE 488 Interface, the LED „R-Control“ indicates that the amplifier is in the remote control mode. In remote control mode the amplifier cannot be controlled via the keyboard.

Exception: For safety reasons the amplifier output can be switched off with the key „OUTPUT“ even in remote control mode.

Move the cursor in the main menu by means of the keys UP or DOWN to **„Lokal“** and press ENTER. Now you have to select **„ON“** in the selection field and press ENTER.

4.3.10. Configuration

The basic configuration of the device can be changed and stored on the configuration menu.

Move the cursor in the main menu by means of the keys UP or DOWN to **„Setup:“** and press ENTER. Now you are requested to enter a numerical code. After input of the correct code you get to the referring set-up window.

The following codes are available:

22314 Configuration of the turn-on values (optional)

Menu item	Section	Short designation
Range:	4.3.4	Amplifier range adjustment
Mode:	4.3.5	Amplifier mode AC- or DC-operation
Voltage:	4.3.6	Voltage adjustment (optional)
Frequ:	4.3.8	Frequency adjustment (optional)
Trigger:	4.3.8	Trigger angle adjustment (optional)

21303 Configuration of the IEEE 488 Interface (optional):

Menu item	Section	Short designation
Address	4.4.2	Interface address
Termination	4.4.2	LF (Line Feed) or CR (Carriage Return)

11211 Configuration of the RS232 / RS485 Interface

RS232 Interface:

Menu item	Section	Short designation
Handshake	4.4.1	RS232 (not active)
Termination	4.4.1	LF (Line Feed) or CR (Carriage Return)
Baudrate	4.4.1	Interface speed

RS485 Interface (optional):

Menu item	Section	Short designation
Address	4.4.1	0/16
Termination	4.4.1	LF (Line Feed) or CR (Carriage Return)
Baudrate	4.4.1	Interface speed

After having completed the adjustments the configuration window can be left with ESC. The following edit window requests either to store or break-off the process.

4.3.11. Monitor Outputs (optional)

The monitor outputs are short-circuit proof and electrically isolated (output impedance approx. 1 kΩ).

Voltage monitor output:

The voltage monitor output corresponds to the ration 1:100 (1V monitor voltage corresponds to 100V output voltage).

Current monitor output:

The menu item **„Monitor:“** controls the divider ratio of the current measurement.

Nominal power	Ratio	Nominal power	Ratio
1000VA	1:1 und 1:10	15000VA	1:4 und 1:40
2500VA	1:1 und 1:10	20000VA	1:4 und 1:40
5000VA	1:1 und 1:10	25000VA	1:5 und 1:50
7500VA	1:2 und 1:20	30000VA	1:10 und 1:100
10000VA	1:2 und 1:20		

Example: When using an amplifier <7.5kVA the possible adjustments are:
1:1 (1V monitor voltage corresponds to 1A)
1:10 (1V monitor voltage corresponds to 10A).

Move the cursor in the main menu by means of the keys UP or DOWN to **„Monitor:“** and press ENTER. Here the requested divider ratio can be adjusted. There is no interface command for this function.

4.3.12. Current Limitation (optional)

The maximum output current can be limited with the current limitation.

Move the cursor in the main menu by means of the keys UP or DOWN to **„I-Limit:“** and press ENTER. In the following window the current limitation value can be adjusted and the current limitation mode can be selected.

The following operation modes are available:

OFF Current limitation off (standard)
REGUL Current regulation
CUOFF Switching off the amplitude at I-Limit

After a re-starting the device the current limitation is always deactivated.

When the current limiting value is exceeded in the operation mode „REGUL“ the output voltage is reduced till the output current no longer exceeds the current limiting value.

At operation mode „CUOFF“ the output of each amplifier is switched off as soon as the current exceeds the adjusted current limiting value.

Caution: The current limitation can only be applied when using the internal control source. Current limitation/current switching off is not possible if the amplifier is controlled via an external function generator because the amplitude of the control can not be influenced.

4.3.13. Switch off

The device is protected electronically against overload, overtemperature and short circuit. Faults are indicated by the red signal lamp „Error“.

If an overload remains for more than 4 seconds, the control and the output contactor are disconnected. The display shows an error message.

When confirming the error message, the device can be started up again.

If the device switches off for thermal reasons (e.g. overheating of the output stages or the transformers) several minutes for cooling are required before the amplifier can be started up again.

4.3.14. External Control

The amplifier can be controlled via the external control input (31) within the scope of its technical data (e.g. amplitude and frequency). 3,535V_{rms} (5V_p) correspond to the present range limit value.

Example: At range 270V and 3.011V_{rms} control voltage the output voltage corresponds to 230V_{rms}.

If the device is provided with the internal oscillator type DDS2 the external input is designed as adder input. Harmonics can be easily generated with this adder input.

Caution: When controlling the amplifier via SyCore the external input (31) is not available. (The sockets are internally connected to the plug „Analog I/O at the SyCore.)

4.3.15. Floating Output (Option 17-300)

The amplifier output is isolated from mains and earth. The amplifier is connected capacitively with earth by means of the coupling capacitance of the mains transformer.

Caution: **There is no protective separation according to the relevant VDE standards.**

4.3.16. Internal Resistance (Option 24-P)

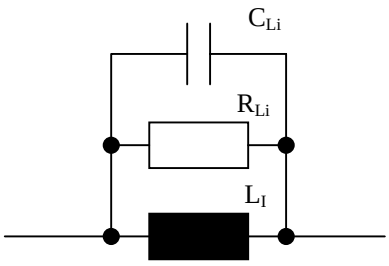
In the menu items **„R:“** and **„L:“** the real and inductive internal resistance of the amplifier can be adjusted. If both values are set to “0” the internal resistance is ≤10mΩ.

Move the cursor in the main menu to **„R“** or **„L:“** and press ENTER. Now the requested internal resistance can be adjusted. Adjustable values for the real internal resistance: 0.0mΩ...8.0Ω; for the inductive internal resistance: 0.0...12.8mH.

Caution: **Adjusting high inductive internal resistance and capacitive load may cause amplifier output voltage exceeding the upper range value and shall be avoided.**

Frequency behaviour

In higher frequencies the inductive share does not behave purely inductive any more. First approximation: see equivalent circuit diagram below:



Formula:

L_I adjusted inductivity

$$R_{Li} = 72.8\frac{1}{\mu F}\cdot\sqrt{17.17\,pF\cdot L_i}$$

$C_{Li} = 2.747\ \mu F$

4.4. RS232 or RS485 and IEEE 488 (optional)

The device can be controlled either via RS232 or IEEE 488 interface. Various commands and queries are available.

The devices are delivered with diverse interface assembling so please check the interface of your device (RS232 or IEEE or RS232/IEEE).

4.4.1. RS232 or RS485

This section describes the module RS232/RS485. This module is a serial communication standard that enables the communication of the device with an external controller e.g. a computer or a terminal.

Before communication can be set up the applied terminal program has to be adjusted to the interface data of device.

Standard configuration:

Baudrate	9600 B/s
Databit	8
Stopbit	1
Parity	no
Handshake:	none

If required, the interface parameters can be changed in the configuration menu (section 4.3.10).

For the connection of the device a 1:1 cable is required (no „Null-Modem“ cable).

Caution: Command sequences which are transferred via the RS232/RS485 interface have to be closed with the character (CARRIAGE RETURN, HEX: 0D).

4.4.2. IEEE 488

This section describes the installation of the IEEE module. IEEE 488 is a parallel 8 bit communication standard that enables the communication of the device with an external controller e.g. a computer or a terminal.

To each device a single IEEE address is assigned. The application of one address for two devices is not allowed.

The IEEE address is set to 9.

If required, the IEEE address can be changed in the configuration menu (section 4.3.10).

4.4.3. Command Syntax

A command consists of the elements command, space and argument.

Example: `AMP:Output 1`

AMP:Output is the command, 1 is the argument. Between command and argument there is always a space.

The capital letters of the command must be input, the lower case letters are optional.

If several commands shall be transferred in one transfer sequence the commands have to be separated with a semicolon.

Example: `AMP:Mode 1;AMP:Output 1`

A query is consists of a command and a question mark.

Example: `MEAS:Voltage?`

When using RS232/RS485 interface the return value is transferred immediately. When using IEEE interface the return value is available for transmission in an output buffer.

The device has a maximum input buffer with 256 characters. In this input buffer the transferred characters are stored until the command is executed. If more than 256 characters are fed the following characters are rejected until memory is available.

The following notation is used for the description of the command syntax:

Symbol	Meaning
< >	Defined element
{ }	Group, one element is required
[ ]	Optional, can be omitted
|	Exclusive Or
...	Previous element(s) may be repeated

Example:

```
AMP:Output {0 | 1}
```

4.4.4. List of Commands

Interface

Description	Command	Section
Reset to initial state	DCL	4.4.5
Reset to local mode	GTL	4.4.6
Query identification of the device	*IDN	4.4.7

Voltage Amplifier

Description	Command	Section
Switch/Query the amplifier operation mode	AMP:Mode	4.4.8
Switch/Query the output contactor	AMP:Output	4.4.9
Set/Query the amplifier range	AMP:Range	4.4.10
Set/Query the current limitation	CURR:Limitation:Mode	4.4.11
Set/Query the current limitation value	CURR:Limitation:Level	4.4.12
Read r.m.s. value of the current	MEAS:CURRent?	4.4.13
Read apparent power	MEAS:S?	4.4.14
Read r.m.s. value of the voltage	MEAS:VOLT?	4.4.15
Set/Query the amplitude	OSC:AMPlitude	4.4.16
Set/Query the frequency	OSC:FREQuency	4.4.17
Set/Query the trigger angle	OSC:TRigger	4.4.18
Switch/Query the real internal resistance	AMP:IMPedance:R	4.4.19
Switch/Query the inductive internal resistance	AMP:IMPedance:L	4.4.20

Register

Description	Command	Section
Clear Device Status Register	*CLS	4.4.19
Set/Query the Bits in ESER	*ESE	4.4.22
Display the contents of SESR	*ESR	4.4.23
Read DSR	*IST	4.4.24
Generate the message „Operation Complete“	*OPC	4.4.25
Set/Query the Bits in SRER	*SRE	4.4.26
Query the contents of SBR	*STB	4.4.27
Set/Query the Bits in DESER	DESE	4.4.28
Mask DSR	DSER	4.4.29

4.4.5. DCL (no query)

With this command the device can be reset to the initial state (starting state). The manual describes how to change the initial state (section 4.3.10 and 4.4.1).

Execution time: 4.2ms

Group

Interface

Syntax

DCL

Arguments

None

Return

Example

```
DCL
```

The device is reset to the initial state.

4.4.6. GTL (no query)

With this command the amplifier is reset from computer control to manual control.

Execution time: 4.2ms

Group

Interface

Syntax

GTL

Arguments

None

Return

None

Example

```
GTL
```

The amplifier is reset to manual control.

*4.4.7. *IDN (only query)*

Returns the oscilloscope identification code in IEEE 488.2 notation.

Execution time: 2.6ms

Group

Interface

Syntax

***IDN?**

Arguments

{ ? }

Return

<String>

Example

```
*IDN?
```

Return:

```
SPS xxx yyy
```

X = device type
Y = version number

4.4.8. AMP:Mode

With this command the operation mode of the amplifier can be switched and/or queried.

Execution time: 220ms

Group

Amplifier

Syntax

AMP:Mode { 0 | 1 }

AMP:Mode?

Arguments

{ 0 | 1 }	0	=	DC-mode on (AC-mode off)
	1	=	DC-mode off (AC-mode on)

In AC-mode a capacitive filter is switched between amplifier input and input signal terminals to suppress DC-components of the input signal.

Return

None

Example

```
amp:mode 0
```

The amplifier is switched to DC mode.

```
amp:mode?
```

The current amplifier mode is returned.

4.4.9. AMP:Output

With this command the output contactor of the amplifier can be switched and/or queried.

Execution time: 270ms

Group

Amplifier

Syntax

AMP:Output { 0 | 1 }

AMP:Output?

Arguments

{ 0 | 1 }	0	=	Output contactor off
	1	=	Output contactor on

If the output contactor is switched off, no voltage and/or applies at the output terminals. When switching the output contactor the control is always adjusted to 0V/0A (see also section: output).

Return

None

Example

```
amp:output 1
```

The output is switched on.

```
amp:output?
```

The current state of the output is returned.

4.4.10. AMP:Range

With this command the amplifier range can be adjusted and/or queried. The number of the voltage or current ranges depends on the type of amplifier.

Execution time: 1750ms

Group

Amplifier

Syntax

AMP:Range <INT1>

AMP:Range?

Arguments

<INT1> Number of the range
0 = Auto range
1 = Smallest range (e.g. 135V)
2 = Next range (e.g.270V)

When „Autorange“ is adjusted the amplifier selects the range according to the adjusted voltage or current value (see section 4.3.4).

At amplifiers with several ranges the smallest range is always adjusted with argument 1. The other ranges follow in ascending order.

Example for an amplifier with the ranges 65V, 135V and 270V:

amp:range 0 = autorange

amp:range 1 = 65V

amp:range 2 = 135V

amp:range 3 = 270V

Return

None

Example

```
amp:range 1
```

The amplifier is switched to range 1.

```
amp:range?
```

The currently adjusted range is returned.

4.4.11. CURR:Limitation:Mode

With this command the current limitation can be adjusted and/or queried. Three modes are available. In mode 0 the current limitation is switched off. In mode 1 the output current is limited to the specified current value. In mode 2 the output of each amplifier is switched off when exceeding the specified current value.

Execution time: 5.2ms

Group

Amplifier

Syntax

CURR:Limitation:Mode <INT1>

CURR:Limitation:Mode?

Arguments

{ ? }

<INT1> Mode

0	=	Current limitation off
1	=	Current regulation
2	=	Switching off

Return

<Number string> The currently adjusted mode is sent back.

Example

```
curr:l:m 1
```

The current regulation is switched on.

```
curr:l:m?
```

The current regulation mode is returned.

4.4.12. CURR:Limitation:Level

With this command the current limitation value can be adjusted and/or queried.

Execution time: 3.7ms

Group
Amplifier

Syntax

CURR:Limitation:Level <FLOAT1>

CURR:Limitation:Level?

Arguments
{ ? }

<FLOAT1> Current limitation value

Return
<Number string> The currently adjusted limitation value is sent back.

Example

```
curr:l:l 3.2
```

The limitation value is set to 3.2A.

```
curr:l:l?
```

The current limitation value is returned.

4.4.13. MEAS:CURRent? (only query)

With this command the r.m.s value of the current via interface can be read out.

Execution time: 3.9ms

Group

Measurement

Syntax

MEAS:CURRent?

Arguments

None

Return

<string> r.m.s. value of the current with unit of measurement

Example

```
meas:current?
```

The present current is returned.

4.4.14. MEAS:S? (only query)

With this command the apparent power can be read out via interface.

Execution time: 4.1ms

Group

Measurement

Syntax

MEAS:S?

Arguments

None

Return

<string> Apparent power with unit of measurement

Example

```
meas:s?
```

The present apparent power is returned.

4.4.15. MEAS:VOLT? (only query)

With this command out the r.m.s. value of the voltage can be read out via interface.

Execution time: 4.4ms

Group

Measurement

Syntax

MEAS:VOLT?

Arguments

None

Return

<string> r.m.s. value of the voltage with unit of measurement

Example

```
meas:volt?
```

The present voltage is returned.

4.4.16. OSC:AMPlitude

With this command the amplitude can be adjusted and/or queried.

Execution time: 1750ms (with range switching)
20ms (without range switching)

Group

Oscillator

Syntax

OSC:AMPlitude <FLOAT1>

OSC:AMPlitude?

Arguments

<FLOAT1> Amplitude value
Valid range: 0 .. „Maximum value“

Return

<FLOAT1>

Example

```
osc:amp 230
```

The amplitude is adjusted to 230V at a voltage amplifier.

```
osc:amp?
```

The adjusted amplitude value is returned.

4.4.17. OSC:FREQuency

With this command the frequency can be adjusted and/or queried.

Execution time: 5.4ms

Group

Oscillator

Syntax

OSC:FREQuency <FLOAT1>

OSC:FREQuency?

Arguments

<FLOAT1> Frequency value
Valid range: „Minimum value“ .. „Maximum value“

Return

<FLOAT1>

Example

```
osc:freq 50
```

The frequency is adjusted to 50Hz.

```
osc:freq?
```

The adjusted frequency value is returned.

4.4.18. OSC:TRigger

With this command the trigger angle can be adjusted and/or queried. The trigger angle determines the time of amplitude change. If the frequency is smaller than 10 Hz the trigger angle is ignored.

Execution time: 5.0ms

Group

Oscillator

Syntax

OSC:TRigger <FLOAT1>

OSC:TRigger?

Arguments

?	initiates a query
FLOAT1	Trigger value Valid range: „-360.0“ .. „+360.0“

Return

<FLOAT1>

Example

```
osc:trigger 90
```

The trigger angle is adjusted to 90°.

```
osc:trigger?
```

The present trigger angle is returned.

4.4.19. AMP:IMPedance:R

With this command the real internal resistance can be adjusted and/or queried.

Execution time: approx. 10ms

Group

Amplifier

Syntax

AMP:IMPedance:R <FLOAT1>

AMP:IMPedance:R ?

Arguments

<FLOAT1> Internal resistance value in Ohm
valid range: 0.0...8.0

Return

<FLOAT1> The currently adjusted real internal resistance value is returned.

Examples

```
amp:imp:r 1.2
```

The real internal resistance is adjusted to 1.2Ω.

```
amp:imp:r?
```

The currently adjusted real internal resistance value is queried.

4.4.20. AMP:IMPedance:L

With this command the inductive internal resistance can be adjusted and/or queried.

Execution time: approx. 10ms

Group

Amplifier

Syntax

AMP:IMPedance:L <FLOAT1>

AMP:IMPedance:L ?

Arguments

<FLOAT1> Internal resistance value in mH
Valid range: 0.0 .. 12.8

Return

<FLOAT1> The currently adjusted inductive internal resistance value is returned.

Examples

```
amp:imp:L 1.2
```

The inductive internal resistance is adjusted to 1.2mH.

```
amp:imp:r?
```

The currently adjusted inductive internal resistance value is queried.

*4.4.21. *CLS*

This command clears the DSR (Device Status Register) concerning the error message; the other information remain. The SESR (Standard Event Status Register) is cleared completely. The flag ESB (Event Status Bit) is reset in the SBR (Status Byte Register). If the amplifier is in error mode this error is cleared. Subsequently, the amplifier is ready for operation.

Execution time: 1.7ms

Group

Interface

Syntax

***CLS**

Arguments

None

Return

None

Example

```
*CLS
```

*4.4.22. *ESE*

Sets and queries the bits in the Event Status Enable Register (ESER). The ESER prevents events from being reported to the Status Byte Register (STB). For a more detailed discussion of the use of these registers, see section 4.5.1.

Execution time: 2.3ms

Group

Interface

Syntax

***ESE <INT1>**

***ESE?**

Arguments

? results in a query of the Event Status Enable Registers

INT1 the Event Status Enable Register is written

0 <= INT1 <= 255.

Return

<decimal number string>

Example

```
*ESE 9
```

masks the Bit0 and 3 (OPC and DDE).

Return:

None

```
*ESE?
```

Query of the register

Return:

<9>

The register indicates that OPC and DDE are masked.

*4.4.23. *ESR*

Returns the contents of the Standard Event Status Register (SESR). *ESR? Also clears the SESR (since reading the SESR clears it). For a more detailed discussion of the use of these registers see section 4.5.1.

Execution time: 2.4ms

Group

Interface

Syntax

***ESR?**

Arguments

{ ? } ? results in a query of the Standard Event Status Registers.

Return

<decimal number string>

Example

*ESR?

Return:

<33>

33 <=> 21hex

The register indicates: a command has arrived; Operation Complete

*4.4.24. *IST (only query)*

With this query the Device Status Register of the amplifier can be read out.

Execution time: 2.6ms

Group

Amplifier

Syntax

***IST?**

Arguments

{ ? }

Return

<String> The return string consist of 4 numbers

Number 0 indicates output mode
Number 1 indicates the active range
Number 2 indicates the mode (AC or DC)
Number 3 indicates the error code

<String>

Example

```
*IST?
```

Return:

0,1,1,113

first number (0)	output open
second number (1)	range 1 is set
third number (1)	AC-Mode is active
fourth number (113)	error message QUERY ERROR.

*4.4.25. *OPC*

Generates the message *"Operation Complete"* in the Standard Event Status Register (SESR) when all pending operations finish. The *OPC? query places the ASCII character "1" into the output queue when all pending operations are finished. The *OPC? response is not available to read until all pending operations finish. For a complete discussion of the use of these registers and the output queue, please refer to section 4.5.1.

Execution time: 2.0ms

Group

Interface

Syntax

***OPC**

Arguments

None

Return

None

Example 1:

Requested state: output on, range2, DC-mode, frequency 0Hz, voltage -280V. SRQ shall be released when the adjustments are set.

```
amp:range 2;amp:mode 0;osc:frequ 0;amp:output 1;osc:ampl
-280;*opc
```

Example 2:

The voltage is to rise continuously from 0V to 135V.

```
amp:ramp 1,*opc,osc:ampl 135
```

In both cases a SRQ-interrupt is released when the device has reached the requested state.

*4.4.26. *SRE*

Service Request Enable sets and queries the bits in the Service Request Enable Register (SRER). For a complete discussion of the use of these registers, see section 4.5.1.

Execution time: 2.9ms

Group

Interface

Syntax

***SRE <INT1>**

***SRE?**

Arguments

? releases a query

INT1 the Service Request Enable Register is written

INT1 = 32 (for ESB) or INT1 = 16 (for MVA)or both; then: INT1 = 48.

Return

<decimal number string>

Example

```
*SRE 32
```

Return:

None

```
*SRE?
```

Return:

```
32
```

The Bit5 ESB is masked an therefore forces an SRQ interrupt.

*4.4.27. *STB (only query)*

Read Status Byte query returns the contents of the Status Byte Register (SBR) using the Master Summary Status (MSS) bit. For a complete discussion of the use of these queries, see section 4.5.

Execution time: 2.9ms

Group

Interface

Syntax

***STB?**

Arguments

{ ? }

Return

<decimal number string>

Example

*STB?

Return:

6

Bit6 (RQS_MSS) and Bit5 (ESB) is set.

4.4.28. DESE

Sets and queries the bits in the Device Event Status Register (DESER). The DESER is the mask that determines whether or not events are reported to the Standard Event Status Register (SESR), and entered into the Event Queue. For a more detailed discussion of the use of these registers, please see section 4.5.1.

Execution time: 4.2ms

Group

Interface

Syntax

DESE <INT1>

DESE?

Arguments

? releases a query

INT1 the Device Event Status Enable Register is written

0 <= INT1 <= 255.

Return

<decimal number string>

Example

```
DESE 49
```

Return:

None

```
DESE?
```

Return:

49

The decimal number 49 corresponds to a hexadecimal representation 31hex. That means: Bit5 (CME) Bit4 (EXE) and Bit0 (OPC) are set.

4.4.29. DSER

The command DSER enables a mask of the Device Status Register (DSR). Since possibly not all information of the Device Status Register shall be accepted in the Standard Event Status Register you have the possibility to pick out mask individual items. The Device Status Register is structured as follows:

DSR

Output	Range	Mode	Error

Error:

All arising errors are written at position 0 (a number between 100 and 255). The meaning of the numbers is described in the table in section 4.5.9.

Mode:

Position 1 indicates which mode is active (0 = DC-Mode; 1 = AC-Mode).

Range:

Position 2 indicates which range is active (1 = first range, 2 = second range etc.)

Output:

Position 3 indicates whether the output is open (0) or closed (1).

Execution time: 4.2ms

Group

Interface

Syntax

DSER<INT1>

DSER?

Arguments

? releases a query

INT1 the Device Event Status Enable Register is written

0 <= INT1 <= 65535.

Return

<decimal number string>

Example

```
DSER 1
```

Return:

None

```
DSER?
```

Return:

1

Bit0 (ERROR) is set.

4.4.30. Example

Requested configuration:

- DC voltage -380Volt at the output
- Output contactor closed
- The voltage is to rise slowly from 0V to the requested voltage (-380V)
- Release SRQ interrupt

How to go on:

1. First all registers have to be programmed to enable the SRQ.
2. The amplitude has to be adjusted to 0V.
3. Since a DC-voltage is required, the frequency has to be adjusted to 0Hz.
4. Switch the amplifier to DC mode.
5. The output has to be closed.
6. The voltage is to rise continuously.
7. Programming of the final voltage.
8. Release the SRQ

Commands:

1.	"dese 1"	Set Bit0 (OPC) in DESE-Register
	"*ese 1"	Set Bit0 (OPC) in ESE-Register
	"*sre 32"	Set Bit5 (ESB) in SRE-Register
2.	"osc:amp 0"	
3.	"osc:frequ 0"	
4.	"amp:mode 0"	
5.	"amp:output 1"	
6.	"amp:ramp 1"	
7.	"osc:amp -380"	
8.	"*opc"	

4.5. Status and Events

The device provides a status and event reporting system for the IEEE and RS232/RS485 interfaces. This system informs about certain significant events that occur within the device.

The device status reporting system consists of six 8-bit Register and an 8-digit array. This section describes these registers and the array and explains how the event handling system operates.

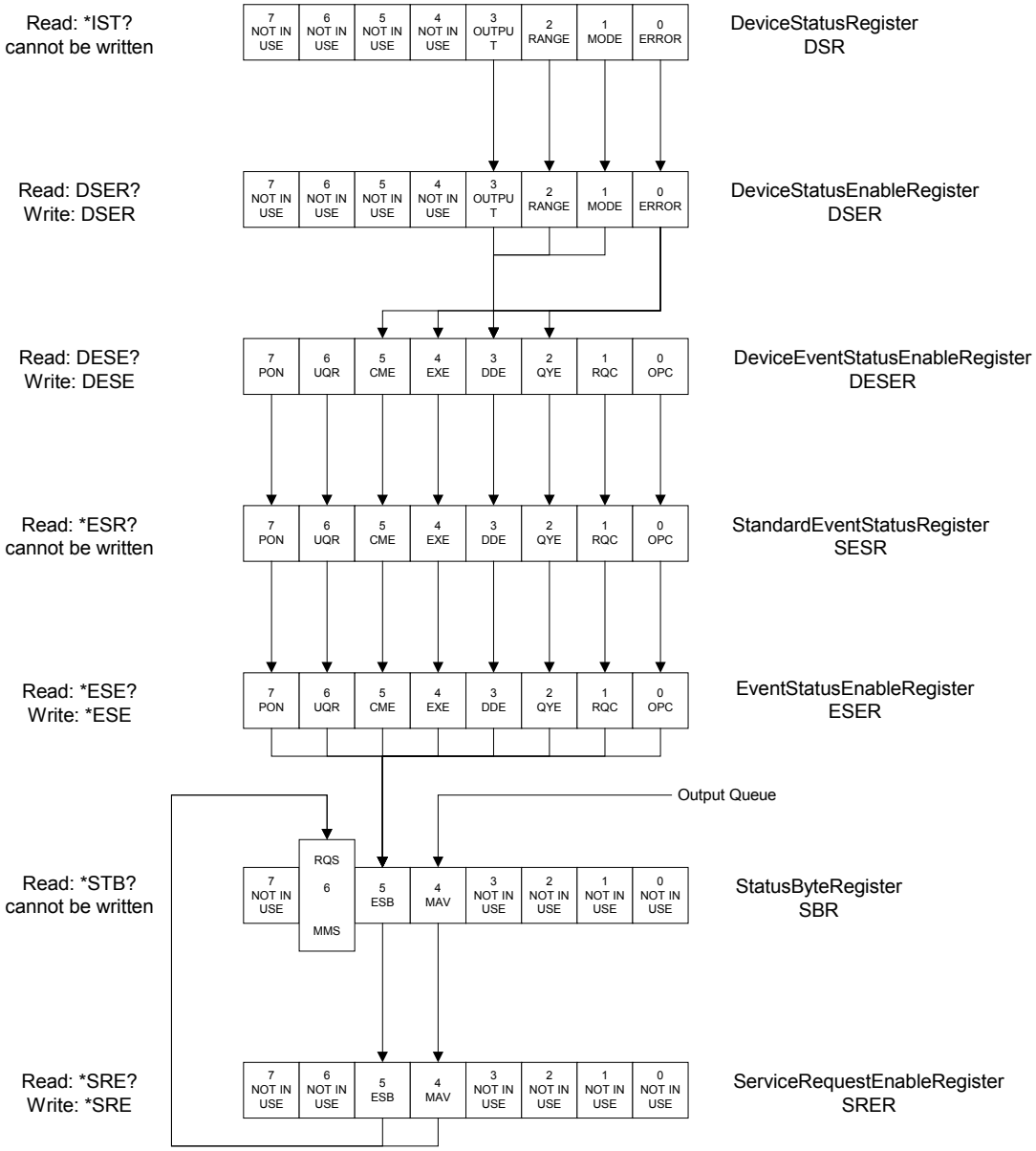
Specific events like e.g. the state of the output or errors are stored in the Device Status Register (DSR). Via the following registers you can lay down which events are passed on and stored and how to do this. So, you can e.g. release a Service Request (SRQ) when the output is switched on or store an event until you have the time to query it.

4.5.1. Register

The registers in the event reporting system fall into two functional groups:

- The Status Registers: The Device Status Register (DSR), the Standard Event Status Register (SESR) and the Status Byte Register (SBR) contain information about the device.
- The Enable Registers: The Device Status Enable Register (DSER). the Device Event Status Enable Register (DESER), the Event Status Enable Register (ESER) and the Service Request Enable Register (SRER) determine whether selected types of events are reported to the Status Registers and the Event Queue.

Register Overview



4.5.2. Device Status Register (DSR)

The Device Status Register is a 8-digit char array. In this array the present status of the device is stored. With the command *DSR? the contents of the array can be read out. The meaning of the array elements are listed in the table 4.5.9.

4.5.3. Device Status Enable Register (DSER)

The Device Status Enable Register (DSER) controls which events stored in the DSR are reported to the DESER.

Use the command DSER to enable or disable the individual bits in the DSER. With DSER? the register can be read out. Every bit in the DSER represents a char digit in the DSR.

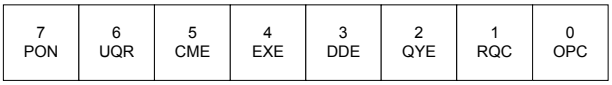
4.5.4. Device Event Status Enable Register (DESER)

The Device Event Status Enable Register controls which types of events are reported to the SESR and the Event Queue. The bits in the DESER correspond to those in the SESR.

Use the DESE command to enable and disable the bits in the DESER. Use the DESE? query to read the DESER.

4.5.5. Standard Event Status Register (SESR)

The SESR records eight types of events that can occur within the device. Use *ESR? To read the SESR register. Reading the register clears the bits of the register so that the register can accumulate information about new events. The following table shows SESR bit functions.



Bit	Label	Function
7(MSB)	PON	(Power On) Shows that the oscilloscope is switched on
6	UQR	(User Request) Not used
5	CME	(Command Error) Wrong command received (see section 4.5.9.)
4	EXE	(Execution Error) Command not executed (see section 4.5.9.)
3	DDE	(Device Error) A device error occurred (see section 4.5.9.)
2	QYE	(Query Error) No response
1	RQC	(Request Control) Not used
0(LSB)	OPC	(Operation Complete) Shows that the operation is complete..

4.5.6. Event Status Enable Register (ESER)

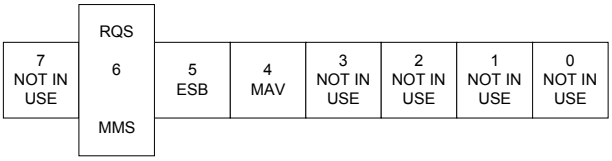
The Event Status Enable Register controls which types of events are summarized by the Event Status Bit (ESB) in the SBR.

Use the *ESE command to set the bits in the ESER, and use the *ESE? query to read it.

4.5.7. Status Byte Register (SBR)

The Status Byte Register records whether output is available in the Output Queue, whether the device requests service and whether the SESR has recorded any events.

Use a Serial Poll (IEEE only) or *STB? to read the contents of the SBR. The bits in the SBR are set and cleared depending on the contents of the SESR, the Event Status Enable Register (ESER) and the Output Queue. When you use a Serial Poll to obtain the SBR, bit 6 is the RQS bit. When you use the *STB? query to obtain the SBR, bit 6 is the MSS bit. Reading the SBR does not clear the bits. The following table shows the SBR bit functions.

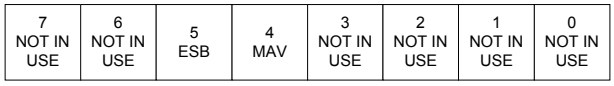


Bit	Label	Function
7(MSB)		Not used
6	MSS	(Request Service) IEEE Interrupt for Serial Poll
5	ESB	(Event Status Bit) Shows that status is enabled and present in the SESR.
4	MAV	(Message Available) Shows that output is available in the Output Queue.
3-0		Not used

4.5.8. Service Request Enable Register (SRER)

The Service Request Enable Register controls which bits in the SBR generate a Service Request (IEEE only) and are summarized by the Master Status Summary (MSS) bit.

Use the *SRE command to set the SRER. Use the *SRE? query to read it. The RQS bit remains set to one until either the Status Byte Register is read by a Serial Poll (IEEE only) or the MSS bit changes back to a zero.



4.5.9. Codes DSR

Error

Name	Code	Meaning
errINTERFACEBUFFERFULL	**101**	Input buffer full
errINTERFACEBUFFEREMPTY	**102**	Output buffer empty
errWRONGPARAMETERSWITCH	**103**	Wrong transfer parameter
errBADINTERRUPTIEEE	**104**	IEEE-Interrupt without being addressed
errEEPROMDAMAGE	**105**	An Eprom is damaged
errEVENTSTACKFULL	**106**	too many external demands
errI2C2PORTERROR	**107**	I²C-Bus error
errAMPLIFIEROFF	**108**	Amplifier has switched off
errOVERLOAD	**109**	Long lasting overload
errOVERHEAT	**110**	Overtemperature of output stage or transformer
errTRIGGERTIMEOUT	**111**	Zero crossing detector damaged
errUNREACHABLEMODE	**112**	Mode cannot be adjusted
errQUERYQUEUEEMPTY	**113**	No query result
errPARAMETERNOTVALID	**114**	Value passing beyond range
errCOMMANDNOTVALID	**115**	Unknown command
errOVERVOLTAGE	**116**	Overvoltage
errPOWERDROP	**117**	Pulse-like drop in the supply voltage
errCURRENTOVERFLOW	**118**	Current switching-off has intervened
errPROTECTIONERROR	**119**	Cannot been carried out at the moment
errNOTINSTALLED	**120**	This option is not installed
errFLOATINGOUTPUT	**121**	Overvoltage between earth and ground
errCURRLIMITATION	**122**	Amplifier in current limitation mode
errCURRSWITCHOFF	**123**	Amplifier in current switch off mode

Mode

Name	Code	Meaning
modeDC	**0**	DC mode active
modeAC	**1**	DC mode not active

Range

Name	Code	Meaning
range135V	**1**	Amplifier range 135V active
range270V	**2**	Amplifier range 270V active
etc.		

Output

Name	Code	Meaning
outOPEN	**0**	Output open
outCLOSED	**1**	Output closed

4.6. Technical Data

Amplifier data:

Nominal voltage: AC: 60V_{rms} / 150V_{rms} / 300V_{rms}
DC: ±85V / ±212V / ±424V

Additional voltage range: +630V DC

Frequency range: DC...5kHz (-3dB)

Continuous power: AC: 1000VA
DC: 1500W
(at nominal voltage and cos φ > 0.7)

Short-time power: 2000VA
(at nominal voltage for approx. 10min in 300V range, duty factor 1:9)

Peak power: 60V: 1280VA_p
150V: 3200VA_p
300V: 6400VA_p
(for approx. 2…3ms)

Load reaction:
(at nominal load)

Range	Frequency	max.	typ.
60V	DC...450Hz	0.5%	0.5%
60V	450Hz...5kHz	1.0%	0.5%
150V	DC...450Hz	0.5%	0.2%
150V	450Hz...5kHz	1.0%	0.5%
300V	DC...450Hz	0.3%	0.1%
300V	450Hz...5kHz	0.5%	0.5%
+630V	DC	0.6%	0.2%

Harmonic distortion
(at no-load to nominal load)

Range	Frequency	max.	typ.
60V	15Hz...450Hz	0.5%	0.2%
60V	450Hz...5kHz	1.5%	1.0%
150V	15Hz...450Hz	0.1%	0.05%
150V	450Hz...5kHz	1.0%	0.5%
300V	15Hz...450Hz	0.1%	0.05%
300V	450Hz...5kHz	0.5%	0.2%

Slew rate: > 52V/µs (in range 300V)
slew rate < 5µs at 230V_{rms} according to EN 61000-4-11

Maximum input voltage: ±5Vs

Input impedance: approx. 8kΩ

Electronic protection: Overload
Short circuit
Overtemperature

Internal control source (optional):

Type:	DDS2
Wave form:	Sine, DC
Amplitude resolution:	100mV
Frequency range:	0.1Hz…15kHz
Frequency resolution:	100mHz

Digital instrument:

Measuring range: U: 400V
I: 20A

Accuracy U:
Of measured value ±2 digit

Frequency	max.
45Hz…450Hz	0.5%
DC...45Hz; 450Hz...5kHz	1.0%

Accuracy I:
Of measured value ±2 digit

Frequency	max.
45Hz…450Hz	0.8%
DC...45Hz; 450Hz...5kHz	1.6%

General:

Interfaces:	RS232, IEEE488 (optional)
Mains supply:	230V (±10%) 50Hz/60Hz, 16A
Ambient temperature:	0°C up to 40°C
Housing:	19"-plug-in unit (4U), colour light grey (RAL 7035) approx. H=180mm, W=483mm, D=600mm
Weight:	approx. 45kg

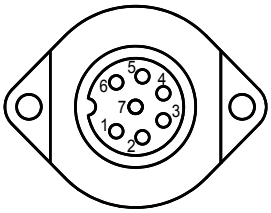
Options:

No.	Description	Available
01	IEEE488 interface (SyCore)	X
06	Voltage monitor	X
07	Current monitor	X
10	Internal resistance compensation	X
11-300z	Special voltage	X
11-630 DC		
13-30	Special frequency range	
17-300	Floating output 300V_{rms}	X
18	Special line voltage	
21	Parallel connection	
24-P	Programmable Internal Resistance	X
28	Voltage adjustment type UT	
D03	DC-control input 0..10V	
D09	Adjustable current limitation	

4.7. Technical Information

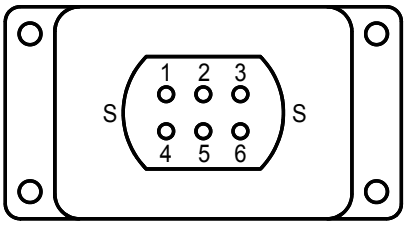
4.7.1. Pin Assignment

Pin assignment „RU_CONTROL“ (22)



1 = Mains
2 = n.c.
3 = Control line „ON“
4 = n.c.
5 = n.c.
6 = n.c.
7 = Protective conductor (PE)

Pin assignment „OUTPUT1“ (24)



1 = Sense line: +Potential (internally connected)
2 = Output line: +Potential
3 = Output line: +Potential
4 = Output line: -Potential (GND)
5 = Output line: -Potential (GND)
6 = Sense line: -Potential (internally connected)
S = Protective conductor (PE)

Pin assignment „CONTROL“ (27)

1 - 11 = n.c.
12 = Overload
13 = Output contactor monitoring
14 = Release
15 = A – RS485
16 = B – RS485
17 - 22 = n.c.
23 = +24V control voltage
24 = n.c.
25 = Control GND

Pin assingment „ANALOG I/O“ (28)

1	=	Input GND
2	=	Input
3	=	U-Signal GND
4	=	U-Signal
5	=	I-Signal GND
6	=	I-Signal
7 – 25	=	n.c.

Pin assignment „RS232“ (29)

1	=	n.c.
2	=	RxD
3	=	TxD
4	=	n.c.
5	=	GND
6	=	n.c.
7	=	n.c.
8	=	n.c.
9	=	n.c.

Pin assignment „IEEE488“ (30)

1	=	DIO1 (data in/out)	13	=	DIO5 (data in/out)
2	=	DIO2 (data in/out)	14	=	DIO6 (data in/out)
3	=	DIO3 (data in/out)	15	=	DIO7 (data in/out)
4	=	DIO4 (data in/out)	16	=	DIO8 (data in/out)
5	=	EOI (end or identify)	17	=	REN (remote enable)
6	=	DAV (data valid)	18	=	GND (TW PAIR W/DAV)
7	=	NRFD (not ready for data)	19	=	GND (TW PAIR W/NRFD)
8	=	NDAC (not data accepted)	20	=	GND (TW PAIR W/NDAC)
9	=	IFC (interface clear)	21	=	GND (TW PAIR W/IFC)
10	=	SRQ (service request)	22	=	GND (TW PAIR W/SRQ)
11	=	ATN (attention)	23	=	GND (TW PAIR W/ATN)
12	=	SHIELD	24	=	SIGNAL GROUND

4.7.2. Miniature Fuses

The miniature fuses are in the front part of the amplifier (right side). The LED's at the boards indicate the condition of the fuses. When a fuse is damaged the corresponding LED doesn't light.

Board ZN 5110 (Auxiliary Supply)

Labelling	Value	Note
F2	T0,5A	Feed step driver pos. side
F3	T0,5A	Feed step driver neg. side
F5	T0,8A	Pre-amplifier –15V
F6	T0,8A	Pre-amplifier +15V

Board ZN4833 (Fan Regulation)

Labelling	Value	Note
F1	T0,5A	Fan regulation